JIANA ZHENG

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RESEARCH INTEREST

Nanomaterials, Electrocatalyst, Perovskites

EDUCATION

University of Science and Technology of China (USTC), China Hefei, China, *08/2020-06/2024*

School of the Gifted Young

BS in Applied Physics (Condensed Matter Physics Track)

- **GPA 3.6/4.3 (86.56/100)**
- **Selected Scholarships & Awards**

National Second-class Prize, China Undergraduate Mathematical Contest in Modeling (CUMCM)	*11/2022*
Provincial Gold Award ,National Business Plan Competition	*05/2022*
Outstanding Contribution Award at School of the Gifted Young Student Union	*03/2022*
Bronze award, Outstanding Student Scholarship	*09/2021*
Bronze award, Outstanding Freshman Scholarship	*09/2020*

RESEARCH EXPERIENCE

➢ **Interest 1: Conversion of small molecules through electrocatalytic methods**

RA in Hefei National Laboratory for Physical Sciences at Microscale, Advisor: Prof. Jie Zeng *USTC, China*

Training : Synthesize Amorphous Cu Nanoparticles for Efficient CO_2 Electroreduction to Liquid fuels *08/2021-11/2021*

- Repeated the experiment published on *Adv. Mater.* 2018, *30*, 1–7
- Synthesized amorphous Cu (a-Cu) nanoparticles using tannic acid at room temperature, and crystallographic Cu (c-Cu) nanoparticles using NaBH4 and PVP
- Determined the concentration of as-synthesized Cu via ICP, gained the experience in how to use GC and NMR to analyze the yields of gas and liquid products, respectively
- Learned the basic research paradigm of electrocatalysis

Project 1: Explore distance effect of single atoms on the stability of cobalt oxide OER catalysts *05/2022-01/2023*

- Synthesized the Ir-$Cu_{0.3}Co_{2.7}O_4$ single atom catalyst (SACs) through high-temperature pyrolysis of metal-organic frameworks (MOFs)
- Estimated average Ir-Ir distances on the exposed surface of SACs through HAADF-STEM image, and identified Ir distribution in catalyst by EDX elemental mapping
- Tested the electrocatalytic performance and the stability in acidic environment of each catalyst, and discovered the optimal Ir-Ir distances (~0.6nm) for stable acidic OER
- DFT calculation indicated that shorter Ir-Ir distances (~0.56nm at minimum) will inhibit the dissolution of cobalt oxide by increasing the migration energies of Co atom on the surface, which agreed well with our experimental results.

Project 2: Electrosynthesis of Oxalate using CO_2 over Pb-based Catalyst *12/2021-06/2023*

- Oxidized the Pb foils in air followed by H_2 reduction in tubular furnace to obtain large uniform high-index lead facets with more catalytic active sites
- Selected Et_4NBF4-DMF as the aprotic electrolyte system to inhibit hydrogen evolution reaction (HER), thereby improving the selectivity of C-C coupling process
- Chose Zn foil as a sacrificial anode to precipitate the generated oxalate ion during the reaction, thus assisted the desorption of $C_2O_4^{2-}$ and managed to maintain a high selectivity of CO_2-to-$C_2O_4^{2-}$ conversion
- Achieved a higher Faradic efficiency of oxalate (~90%) and a higher current (>100mA vs -3.0V) than previously reported
- Gained a deeper understanding of CO_2 reduction mechanism

Project 3: Electrosynthesis of NH_2OH *via* plasma-electrochemical cascade pathway using N_2 and H_2O *12/2022-06/2023*

- Prepared the working electrode by magnetron sputtering Bi NPs onto carbon fiber paper
- Used plasma discharge device to convert N_2 and O_2 into NO_X, and NO_X was then absorbed into water to form NO_3^-
- Adopted an excess amount of CHOCOOH to capture as-electroreducted NH_2OH into glyoxylic acid oxime
- The Bi NPs catalyst exhibit a high FE (73.4%) and selectivity (99.3%) towards NH_2OH
- Project 2 and 3 were aimed to realize full electrosynthesis of glycine (CO_2-$(COOH)_2$-CHOCOOH-NH_2CH_2COOH)

➢ **Interest 2: Synthesis of functional nanomaterials (including metal & perovskites nanostructures)**

Project 1: Continuous Controllable Mass Production of Monodispersed Cu NCs in fluid device *02/2022-10/2022*

Independent Project in Hefei National Laboratory for Physical Sciences at Microscale, Advisor: Prof. Jie Zeng *USTC, China*

- Synthesized mono-dispersed Cu nanocrystals(NCs) via seed-growth mechanism using copper acetate as copper source, ascorbic acid as reductant, and PVP as surfactant
- Improved the purity and uniformity of Cu nanoparticles by decoupling the growth step from nucleation in a flow reactor
- Tuned the concentration of precursor and adjusted the ratio of copper source involved in each step to produce Cu nanoparticles of different sizes
- Tested the stability of continuous synthesis of Cu NCs in an experimental flow chemistry device
- Characterized the morphology of as-synthesized Cu NCs via SEM
- **Achievements:** Won the Provincial Gold Award in the "Challenge Cup" National Business Plan Competition and the **Bronze Award** in "Qingfeng Cup" Innovation and Entrepreneurship Competition of USTC

Project 2: Employ Au nanocages/ZIF series MOFs as host carrier to encapsulate perovskite NCs *07/2023-Present*

Independent Project, Advisor: Prof. Ou Chen, Department of Chemistry *Brown University, United States*

- Synthesized Au nanocages using Ag nanocubes as templates via galvanic replacement
- Imparted functional nanostructures (like Ag nanocubes and QDs) in ZIF-8 nanoparticles
- Try to use zwitterionic ligands (like lecithin) and ligand-exchange methods to bridge the gap between nanoparticles dispersible in polar and non-polar solvents, thereby loading perovskites in cage-like structure for enhanced stability

First-principles Calculations of Electron-phonon Coupling Phenomenon in GaAs and Si *10/2022-12/2022*

Undergraduate Researcher, Advisor: Prof. Jin Zhao, Department of Physics *USTC, China*

- Obtained skills to run a calculation task on remote supercomputers through personal terminal
- Carried out elementary electron and phonon calculations with DFT and DFPT using Quantum Espresso

UPCOMING PUBLICATIONS

Distance effect of single atoms on the stability of cobalt oxide catalysts for acidic oxygen evolution

Zhirong Zhang[1†], Chuanyi Jia[2†], Peiyu Ma[3†], Chen Feng[1], Jin Yang[1], Junming Huang[1], **Jiana Zheng[1]**, Ming Zuo[1], Shiming Zhou[1]*, Jie Zeng[1,4]*

(Nature Communications 23-43865; Current stage: Manuscript under consideration)

Electrosynthesis of hydroxylamine *via* plasma-electrochemical cascade pathway using the air and water as raw materials

Xiangdong Kong[1,3], Jie Ni[1,3], Zhimin Song[1], Zhengwu Yang[1], **Jiana Zheng[1]**, Zifan Xu[1], Lang Qin,[1] Hongliang Li[1], Zhigang Geng[1,*], Jie Zeng[1,2,*]

(Nature Energy 2309202; Current stage: Manuscript under consideration)

CONTEST EXPERIENCE

Contest Project: Azimuth-only Passive Positioning of UAV in Formation Flight *09/2022*

Core member, responsible for building mathematical models and writing papers

- Created the model in Python and figured out solutions through geometric knowledge and iterative algorithm
- Organized and wrote an academic essay according to solving threads and computational simulation results
- **Achievement:** Won the **National Second-class Prize** in the 2022 China Undergraduate Mathematical Contest in Modeling

RELEVANT COURSEWORK

Synthesis of Cu-based Nanomaterials for Electrocatalytic Reduction of CO_2

(Course: College Physics—Research Experiment) *09/2022-01/2023*

Project Leader, Advisor: Dr. Rucheng Dai *USTC, China*

- Designed and supervised the experiment as the project leader
- Prepared the gas-diffusion working electrode with porous carbon paper and Cu NPs (as the electrocatalyst, which can be produced in the previous Controllable Mass Production project through the flow reactor)
- Tested the electrochemical performance of Cu-based materials and discovered catalytic preferences of each catalyst
- Analyzed the constituent of liquid products via NMR, gas products via GC, and calculated the Faraday efficiency of each kind of product afterwards

TECHNICAL PROFICIENCIES

Computer Skills:

- Database: Scopus, Web of Science, and Google Scholar
- Basic software: Endnote, Origin and MATLAB
- Codes: Python, C, and Linux

Research Skills:

- Proficient in conducting electrochemical experiments using H-cell, flow-cell and software like CHI660E, CHI1140E
- Proficient in many characterization methods, including XRD, SEM, TEM, UV/Vis and fluorescence spectrometer
- Proficient in analytical methods like NMR, IC, GC, and ICP
- Skilled use of software for data analysis, including DigitalMicrograph for TEM/STEM , MestReNova for NMR and Image J (for microscopy photo processing)